Decision Support in Cloud based IoT Applications for the Smart Environment

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Abstract— ***Present years have seen an exceptional change in smart environment paradigms and Cloud based Internet of Things (IoT) organized with big data analytics. IoT enables a common platform for seamless exchange between smart environment and stakeholders with the advanced analysis of the shared bulk data. Cloud computing offers attractive computational and storage solutions to cope with these issues. Edge-Cloud architecture may offer new possibility to distributed cloud based internet of things applications, making best possible decisions concerning where to deploy the different application components is challenging work for the application designers. A decision support system, as a kind of interactive computer-based information system, helps decision makers to make use of data and models to solve mostly semistructured or unstructured decision problems in practice. A decision support system, with knowledge based decision analysis models and methods, incorporate databases, model bases, and intellectual resources of individuals or groups well to advance the quality of complex decisions. This paper provides the details of how much of importance of decision support framework for the cloud and IoT application designers.***

Index Terms—***IoT, Edge computing, Cloud computing, Decision support system, Big data analytics.***

I. INTRODUCTION

Smart connected products and services expand physical components from their traditional core by adding information
and connectivity services using the Internet. Currently Decision Support System provides decision support via text analytics and mining-based decision support systems; ambient intelligence and the IoT-based decision support systems; biometrics-based decision support systems; recommender, advisory, with other technologies and their integration with decision support systems.
Cloud based IoT applications with edge computing has emerged as an significant computing technology, enabling ubiquitous appropriate on-demand access through Internet to a shared collection of configurable computing resources [1]. In this concept, software (applications, databases, other data), infrastructure and computing platforms are widely used as services for data storage, management and processing. They offer a number of benefits, including reduced IT costs, flexibility, as well as space and time complexity. the idea of utilizing distributed resources at the edge of the network and providing the required capabilities closer to the source of data has been proposed recently. This concept is both known as Edge or Fog computing. Although these terms are often used interchangeably [4] [5]. Based on the Edge Cloud model, an cloud based IoT application components can be accomplish on IoT devices, Cloud and Edge nodes. Several edge computing technologies originating from dissimilar environs to reduce latency, and support the gigantic machine type of communication have been emerging. Making a decision on how to correctly distribute components is tricky and requires profound analysis. modern research efforts are investigating on how to efficiently exploit capabilities at the edge of networks to support the Cloud based IoT and its requirements [6].

In IoT, smart and self configuring embedded devices and sensors are unified in a dynamic and global network structure, enabling liveliness flexibility, scalability and ubiquity in fields of huge scale multimedia data processing, storage, access and communications. The precondition to monitor, analyze and act upon these data brings many issues like data confidentiality, data verification, authorization, data mining, secure communication and computation. The IoT based cloud computing systems future development is more and more influenced by Big Data and IoT [2,3].

The Cloud based IoT application problem in an Edge-Cloud model has been investigated in several studies [7,8,9,10]. They mostly focus on how to efficiently allocate the available resources in the Edge or Cloud to satisfy the received requests from IoT applications in order to improve the performance of the system with the minimum cost. Evaluating the different options in Edge-Cloud model at the design time and supporting application and system designers with suggestions would support them to offer services more efficiently taking into account the specific requirements of the distinct IoT application. Moreover, the output of the design-time valuation would support the infrastructure providers to offer more relevant and satisfactory services to the end-users and the designers. The problem of design-time decision support in a hybrid Edge-Cloud model has not been examined yet.

II. DECISION SUPPORT SYSTEM (DSS)

Decision support systems (DSSs) aims to guiding users through some of the decision-making phases and tasks or supplying new capabilities. knowledge-based decision analysis models and methods, integrate databases, model bases, and intellectual resources of individuals or groups well to improve the eminence of complex decisions.

III. IOT, CLOUD AND EDGE COMPUTING

The IoT signifies a modern methods where restrictions between tangible and digital domains are increasingly eliminated by consistently changing every physical device to a smart alternative ready to provide smart services. All things in the IoT (smart devices, sensors, etc.) have their own identity. They are combined to form the communication network and will become actively participating objects [13].

The main characteristics of this IoT data are variety, volume and velocity. Data is generated from huge number of heterogeneous sources with various data formats such as images, scripts, videos, etc. The speed with which data is generating is very high which adds the dynamic factor in the data.

Cloud computing is a computing model for providing anything as a service such that the services are virtualized, shared, and be provisioned and released speedily with minimal management effort. For the users, the services can be accessed conveniently, ubiquitously, across the network, dynamically, and on demand; can be configured with minimal communication with the service provider; and are flexible and metered on a pay-per-use basis. There comes the need of integration of Internet of things with Cloud platform. Cloud computing is very advantageous computing paradigm, which provides the services of software, platform, infrastructure and other resources to various applications on demand. It is a service-based architecture with a shared and configurable pool of resources. Virtualization is the key technique. Services like networking, computation, storage are provided to the user on an on-demand basis. It saves expenditure on hardware, maintenance, security of hardware; power backups, other resources and let the organization focus on their core business. With the cloud platform, mining and analysis of enormous data of ubiquitous sensors of IoT can be innovative with virtually limitless resources and capabilities of the cloud.

Edge computing offers numerous computation capabilities from the distributed devices at the edge of the network. Utilizing Edge computing influences the way of processing data compared to the traditional Cloud architecture. To benefit from both Edge and Cloud computing, hybrid Edge-Cloud models have been proposed [11][12]. However, using such a model enhances more complexity when designing IoT applications. IoT applications characteristically consist of a set of software components that are scattered across the network and have data processing and storage requirements. Adding more possibilities to distribute the components poses challenges concerning how to choose the best solution to deploy application components among all possible combinations. Based on the Cloud based Edge model, an IoT application components can be implemented on IoT devices, Edge nodes, and the Cloud. Making a decision on how to appropriately distribute components is challenging and requires profound analysis

IV. BIG DATA ANALYTICS

A vast repository of terabytes of data that is generated every day from recent information systems and digital technologies such as Internet of Things and cloud computing. Analysis of these massive data involves a lot of efforts at multiple stages to extract knowledge based data for decision making.

The Cloud-based IoT approach involves the management and processing of huge amounts of data stemming from various locations and from heterogeneous sources; indeed, in the Cloud-based IoT, many applications need complicated tasks to be performed in real-time [18], [28].

V. BENEFITS OF INTEGRATING IOT WITH CLOUD

Since the IoT suffers from restricted capabilities in terms of processing power and storage, it must also struggle with issues such as performance, reliability, privacy and security. The integration of the IoT into the Cloud is surely the best way to overcome most of these issues. The Cloud can be benefit from the IoT by intensifying its confines with real world objects in a more dynamic and distributed way, and providing new services for billions of devices in different real life scenarios [13], [14]. billions of users communicating with each together and a variety of information being collected, the world is quickly moving in the direction of the Internet of Everything (IoE) realm - a network of links with billions of things that generate new chances and risks [14]. The Cloud-based IoT approach offers new applications and services based on the expansion of the Cloud through the IoT objects, which in turn allows the Cloud to work with a number of new real world scenarios and leads to the development of new services [15].

VI. CLOUD-BASED IOT ARCHITECTURE

According to several earlier studies, the well-known IoT architecture is typically classified into three different layers: application, perception and network layer. Cloud based IoT architecture will provides a numerous opportunities to make an efficient and effective decision making for cloud based IoT applications, which realizes the Cloud based IoT architecture, as depicted in Fig.1.

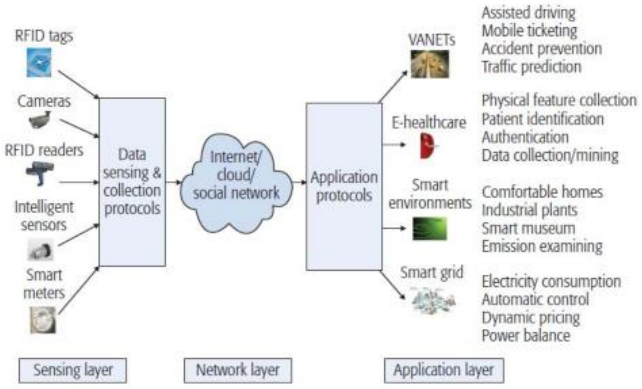

Fig. 1. Cloud-based IoT architecture [1].

The perception layer is used to recognize objects and gather data, which is collected from the neighboring environment. In
contrast, the key objective of the network layer is to transfer the collected data to the Internet/Cloud. Finally, the application layer provides the interface to different services [17].

CONCLUSION

This paper outlines and surveys the decision support system for cloud based IoT applications and edge computing technologies. The main goal of this paper is to provide understanding of further details of the key technologies, Within each of these aspects, we have given a detail on the principle, system architecture, standards, and applications.

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